

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT



(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P13571MA	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/EP2004/051059	International filing date (<i>day/month/year</i>) 08.06.2004	Priority date (<i>day/month/year</i>) 17.06.2003
International Patent Classification (IPC) or both national classification and IPC G10L11/02, H04R3/00, H04R1/40		
Applicant SONY ERICSSON MOBILE COMMUNICATIONS AB et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
 - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

Date of submission of the demand 19.03.2005	Date of completion of this report 07.06.2005
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**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/EP2004/051059

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-6 as originally filed

Claims, Numbers

1-26 received on 19.03.2005 with letter of 17.03.2005

Drawings, Sheets

1/1 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY
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International application No. **PCT/EP2004/051059**

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-15,17-19,20
	No: Claims	16
Inventive step (IS)	Yes: Claims	1-15,20
	No: Claims	16-19
Industrial applicability (IA)	Yes: Claims	1-20
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

Reference is made to the following documents:

D1: US2003/027600

D2: US2002/009203

V.1 Claims 1-15,20

The document D1 is regarded as being the closest prior art to the subject-matter of independent claims 1,20 and shows (the references in parentheses applying to this document):

- a device for voice activity detection (VAD) comprising a sound analyser arranged to determine whether a sound signal comprises speech (abstract, fig.2 block.ref 36) comprising:
- a microphone system arranged to discriminate sounds emanating from sources located in different directions from the microphone system (paragraphs 17,22 fig.2 block ref. 24)

D1 however does not disclose the following feature :

- determine the direction of a sound source causing the signals; and is adapted to further analyse the sound to determine whether the sound signal comprises speech, if the sounds emanate from a first range of directions, but to decide that sound signal does not comprise speech, if the sounds emanate from a second, different range of directions

This feature is thus novel, claims 1 and 20 meet thus the requirements of Art.33(2) PCT.

D1 uses a microphone array in order to enhance signal-to-noise ratio rather than to determine a direction of arrival of sounds. There is therefore no indication in D1 about a

voice activity detection based on a range of directions. The other documents cited in the International Search report do not either provide any indication suitable for this task. Consequently claims 1 and 20 involve an inventive step and meet the requirements of Art.33(3) PCT.

Claims 2-15 are drafted as dependent claims of the device defined in claim 1. For this reason claims 2-15 are also considered novel and involving an inventive step as required under Art.33(2)(3) PCT.

V.2 Claims 16-19

Claim 16 only refers to the microphone system of claim 1, therefore it does not contain all the features of claim 1 and cannot be considered to be a dependent claim under the meaning of Rule 6.4(a) PCT.

Document D2 appears to represent the closest prior art for claim 16 and discloses (the references in parentheses applying to this document):

- an accessory for a mobile apparatus characterized that it comprises a microphone system (fig.9, fig. 12)

For this reason claim 16 is considered to lack novelty and does not meet the requirements of Art.33(2) PCT.

Dependent claims 17-19 are obvious constructional variations based on the accessory of claim 16. They are not considered to involve an inventive step. Claim 17-19 do not meet the requirements of Art.33(3) PCT.

APPROVED PCT/PTO 16 DEC 2005

CLAIMS

1. A device for voice activity detection comprising a sound signal analyser arranged to determine whether a sound signal comprises speech, comprising a microphone system (2a, 2b, 2c, 2d, 2e) arranged to discriminate sounds emanating from sources located in different directions from the microphone system, characterised in that the device is adapted to determine the direction of a sound source causing sound signals;
and is adapted to further analyse the sound to determine whether the sound signal comprises speech, if the sounds emanate from a first range of directions;
but to decide that the sound signal does not comprise speech, if the sounds emanate from a second, different range of directions.
2. A device according to claim 1, characterised in that the first range of directions is directed in the direction of an intended user's mouth (3).
3. A device according to claim 2, characterised in that the microphone system comprises two microphone elements (2a, 2b) separated a distance and located on a line directed in the direction of an intended user's mouth (3).
4. A device according to claim 3, characterised in that the first range of directions is defined as all sounds falling inside a cone with a cone angle α , wherein $10^\circ < \alpha < 30^\circ$.
5. A device according to claim 4, characterised in that α is approximately 25° .
6. A device according to claim 2, characterised in that the microphone system comprises three microphone elements (2b, 2c, 2d) separated a distance and located in a plane directed in the direction of an intended user's mouth (3).
7. A device according to claim 6, characterised in that two (2c, 2d) of said three microphone elements are separated a distance and located on a line directed perpendicular to the direction of an intended user's mouth (3).
8. A device according to claim 2, characterised in that the microphone system comprises four microphone elements (2b, 2c, 2d, 2e), located such that the fourth microphone (2e) is not located in the same plane as the three others (2b, 2c, 2d).
9. A device according to any one of claims 1 to 8, characterised in that the

microphone elements (2a, 2b, 2c, 2d, 2e) are directional with a pattern having maximal sensitivity in the direction of an intended user's mouth (3).

- 5 10. A device according to claim 1, **characterised** in that the microphone system comprises one directional microphone element together with one or more other microphone elements adapted to remove the uncertainty in the direction of the sound source.
- 10 11. A device according to claims 10, **characterised** in that the directional microphone element is adapted to measure the sound pressure level relative to the other microphone element.
- 15 12. A mobile apparatus, **characterised** in that it comprises a device as defined in any one of claims 1 to 11.
13. A mobile apparatus according to claim 12, **characterised** in that the microphone elements (2a, 2b, 2c, 2d) are located at the lower edge of the apparatus.
- 20 14. A mobile apparatus according to claim 12, **characterised** in that a plurality of microphone elements (2a, 2b, 2c, 2d) are located at the lower edge of the apparatus and at least one further microphone element (2e) is located at a distance from the lower edge.
- 25 15. A mobile apparatus according to any one of claims 12 to 14, **characterised** in that it is a mobile radio terminal, e.g. a mobile telephone (1), a pager, a communicator, an electric organiser or a smartphone.
- 30 16. An accessory for a mobile apparatus, **characterised** in that it comprises a microphone system (2a, 2b, 2c, 2d, 2e) as defined in any one of claims 1 to 11.
17. An accessory according to claim 16, **characterised** in that the direction of the first range of directions is adjustable.
- 35 18. An accessory according to claim 16 or 17, **characterised** in that it is a hands-free kit.
19. An accessory according to claim 16 or 17, **characterised** in that it is a telephone conference microphone.

20. A method for voice activity detection, characterised by the steps of:
receiving sound signals from a microphone system (2a, 2b, 2c, 2d, 2e) arranged
to discriminate sounds emanating from sources located in different directions
from the microphone system;
determining the direction of the sound source causing the sound signals;
if the sounds emanate from a first range of directions, further analyse
the sound to determine whether the sound signal comprises speech;
but if the sounds emanate from a second, different range of directions decide
that the sound signal does not comprise speech.
21. A method according to claim 20, characterised in that the first range of
directions is directed in the direction of an intended user's mouth (3).
22. A method according to claims 21, characterised in that the first range of
directions is defined as all sounds falling inside a cone with a cone angle α ,
wherein $10^\circ < \alpha < 30^\circ$.
23. A method according to claims 22, characterised in that α is approximately
 25° .
24. A method according to any one of claims 22 or 23, characterised in that the
microphone system comprises at least two microphone elements (2a, 2b) located
at a distance from each other and located on a line directed in the direction of an
intended user's mouth (3), said two microphone elements being separated a
distance d , wherein the direction to the sound source θ is calculated as
$$\theta = \arccos \frac{\Delta t \cdot v}{2 \cdot d}$$

where
 Δt is the time difference between the sounds from the two microphone elements,
 v is the velocity of sound.
25. A method according to claims 20, characterised in that one directional
microphone element is used together with one or more other microphone
elements to remove the uncertainty in the direction of the sound source.
26. A method according to claims 25, characterised in that the directional
microphone element is used to measure the sound pressure level relative to the
other microphone element.